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Exposition of that year. A brief paper on the subject was presented to the American Physical Society in 1903, and an abstract of this paper was published in the *Physical Review* for April, 1903, but the complete paper with diagrams has not been published. The title of the paper was "A Simple Geometrical Principle and its Possible Significance in Connection with a General Physical Theory," and the principle referred to was stated as follows:

In an aggregation of an indefinite number of equal spherical bodies an arrangement giving minimum total volume and perfect symmetry throughout is impossible.

Three different arrangements of a group of spherical balls of equal size were considered: arrangement A, in which twelve of the balls are grouped about a central one, so the surrounding balls are tangent to the central one and to each other throughout; arrangement B, in which twelve balls are symmetrically disposed about and touch a central one, but nowhere touch each other, and arrangement C, in which the balls have the cubical arrangement, or the one in which the mutually tangent planes form cubes. The following is quoted from the published abstract referred to above:

The assumption is now made that the balls come together in a collection under their mutual attractions according to gravity laws. They will not assume or remain in arrangement C because while this gives symmetry throughout it is not the most compact possible and the equilibrium of the collection would be unstable.

Arrangement A, while the most compact possible for an indefinite number of balls in contact throughout, is not entirely symmetrical.

Arrangement B gives a perfectly symmetrical disposition of twelve balls with respect to a central ball but it is geometrically impossible throughout a collection of a greater number than thirteen.

It is suggested that under the conditions assumed the result will be that the balls will assume no fixed arrangement, but that they will be in continual relative movement, striving after the unattainable arrangement that will give minimum total volume, symmetrical disposition, and therefore fixed stable equilibrium throughout.

So far as I can now recall, I had not learned of the Brownian movements at that time. I certainly did not have this phenomenon in mind when the paper was written. I have not been able to make out that Professor Perrin's paper contains any very clear explanation of or theory as to the underlying *cause* of the Brownian movements, or that it purports to suggest such an explanation or theory, but the relations between the actual phenomenon as described and the above quoted speculation seemed to me rather striking.

In my mind the Brownian movement paper tends to confirm the idea that the "simple geometrical principle" above described is deeply significant, if it is not indeed a general and fundamental principle of physical phenomena.

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FURTHER EARLY NOTES ON THE TRANSMISSION BY FLIES OF THE DISEASE CALLED YAWS

I HAVE previously published in *SCIENCE*¹ two notes on the transmission of this tropical disease by flies. The earlier reference bears date of 1769 from Guiana. The second, while of much later date (1817), indicates that in Brazil at that time the infection was conveyed by a certain fly recognizable by its small size.

Shortly after the publication of this second note, I received a letter from Professor J. B. Woodworth, leader of the Shaler Memorial Expedition to Brazil in 1908-09, in which he kindly called my attention to a further account of this phenomenon in Walsh's "Notices of Brazil." While spending the recent holidays at Washington at work in the Library of Congress, I looked up this reference and also found another and earlier statement. Believing that these accounts may not be devoid of interest and value, they are herewith reproduced.

The one referred to by Professor Woodworth is found in "Notices of Brazil in 1828 and 1829," by R. Walsh, published in Boston in 1831. On page 224 of volume I. we read:

A disease, called in the country *bobas*, is frequently attended with fearful consequences. It

¹ January 7 and November 4, 1910.

resembles the frambesia or yaws of the West Indies. The body swells and breaks out into ulcers, which have often the appearance of mulberries, and the patients become exceedingly loathsome. It is infectious by contact, but is also communicated, *according to the theory of the country*,² in a manner that defies all precaution. The eye sometimes is partially affected, and a small fly is then attracted by the discharge; this insect comes loaded with the contagious matter, and communicates it to the next person, on whose face he happens to light.

It will be noted that Walsh agrees with Koster's statement³ that the disease is transmitted by a certain "small fly from which every precaution is oftentimes of no avail" and that the eye is the part most likely to be affected.

An earlier account of this means of infection is found in J. G. Stedman's "Narrative of a Five Years' Expedition Against the Revolted Negroes of Surinam, in Guiana on the Wild Coast of South America," London, 1796. On page 274 of volume II. he writes:

The yaws, a most disagreeable disorder, by many compared to the venereal disease, renders the patient a shocking spectacle, all covered over with yellow ulcers. To this last mentioned loathsome malady most negroes are subject, yet but once only in their lives, in which, and in being very infectious, it resembles the small-pox: indeed, if a fly which has been feeding upon the diseased (and they are generally covered with them) lights upon the slightest scratch on a healthy person, it communicates this dreadful disorder, which always confines him for several months.

The earliest references to this disease which I have chanced upon are from William Piso. The first occurs under the heading *De Lue Venerea* on page 35 of his *De Medicina Brasiliensi* in "*Historia Naturalis Brasiliæ*," by William Piso and George Marcgrave. Under the heading *De Lue Indica* the same facts are given almost verbatim on page 43 of Book II., *De Natura & Cura Morborum, Occidentali Indiæ, imprimis Brasiliæ, familiarum*, in Piso's "*Historiæ Naturalis & Medicæ Indiæ*

Occidentalis," one of the component parts of "*De Indiæ Utriusque Re Naturali et Medica*," by William Piso and Jacob Bont. The first was published at Leyden and Amsterdam in 1648, the second at Amsterdam by the Elzevirs in 1658.

That part of the account of the disease which is of interest to the general reader translates as follows:

Concerning the Venereal (or Indian) Disease (or Plague). This is a disease which occurs not only in children as a result of inheritance from their parents, and is contracted not only by infection in sexual union, but even by lighter contact. It originates chiefly in fetid and decaying food, and in rancid and corrupt drink. It rages not only among Negroes and Indians, but also among Portuguese and Dutch. The whole body is infested with schirrhous tumors and virulent ulcers. This disease is indeed endemic in that region [Piso was writing of northern Brazil] and by both Spaniards and Brazilians is called *Bubas*.

Careful search failed to show any reference to insects as agents of transmission.

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A THEORY OF SEX DETERMINATION¹

MRS. LAURA A. CALHOUN, a woman of culture, who has had considerable experience in the breeding of animals in California, ventures on the strength of this experience and that of others to propose and develop a theory of the conditions determining sex.

Her main thesis is set forth in these words: "The sex of the embryo in man and the higher animals is determined in the ovary from which the ovum in question is developed. In the normal female, the ovary of the right side yields ova which on fertilization develop as males, and the ovary of the left side yields ova which are potentially female."

From this arises the practical deduction that sex can be determined at will, through the service of gravitation. For the prospective mother to lie on the right side should

¹"The Law of Sex-determination, and its Practical Application," by Laura A. Calhoun, The Eugenics Publishing Company, New York.

²Italics by the present writer.

³See "Note," etc., November 4, 1910.